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(54) Automatic dispensing unit for paste inks and the like.

(57) A dispensing system is provided for accurately dispensing relatively small amounts of product such as paste inks and like viscous materials. The system includes a rotatable turntable (12) on which are mounted, in circumferential spaced relationship, a plurality of product receptacles (14) or canisters containing different product, e.g., paste inks, to be dispensed. The turntable is rotated so as to enable different product receptacles to be positioned at a dispensing station (16), and a weigh scale (20) located at the dispensing station weighs product dispensed from the receptacles and produces a corresponding output. A dispensing control device located at a dispensing station adjacent to the path of travel of the turntable controls opening and closing of the control valve (104) of the receptacle located at the dispensing station so as to control dispensing of product from that receptacle. A controller, which is connected to the weighing device and the dispensing control device, includes a data processing and storage function for storing information relating to the product contained in each of the receptacles, including data relating to a predetermined weight-based "dribble" level and to a final cutoff level, for each product. The controller controls partial closing, and then and full closing, of the control valve of the receptacle at the dispensing station based on the output of the weigh scale and the data relating to the dispensing cutoff levels for that receptacle.

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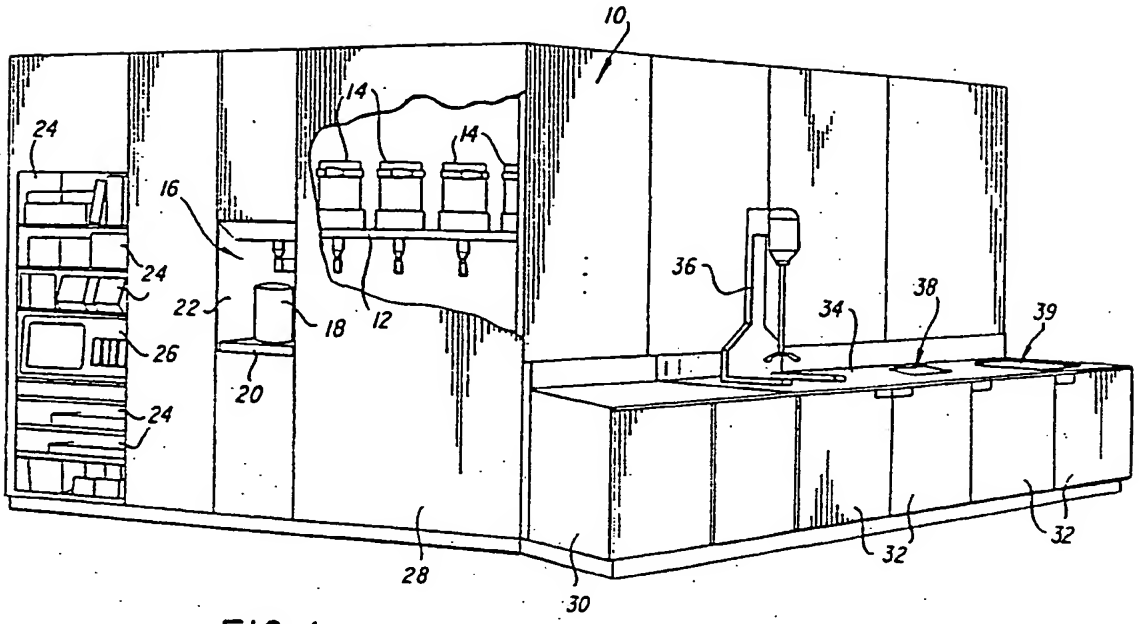


FIG. 1

AUTOMATIC DISPENSING UNIT FOR PASTE INKS AND THE LIKE

The present invention relates to the dispensing of viscous liquids such as paste inks and the like, and, more particularly, to an automatic dispensing unit or system which enables fully automatic dispensing of such inks in small quantities (low weight batches) with high weigh accuracy.

So-called paste inks and other similar high viscosity inks are, because of their viscosity, difficult to dispense and control. Typically, in a prior art installation which offers this kind of service, when an ink of a particular formula is to be made up, the component ingredients are selected from stores of different inks usually in different cans, each of the ingredients is then measured out in the desired quantity by manually pouring out a portion of the contents of a can and then weighing the same, and thereafter the various ingredients so measured out are mixed in a mixing pot to produce an ink of the desired formula. It will be appreciated that such an approach has a large number of drawbacks, including a basic lack of accuracy in dispensing relatively small amounts of different mixtures.

As will appear from the description which follows, the system of the invention employs a turntable or carousel arrangement in mixing different ingredients and, of course, the use of such an arrangement in mixing and dispensing of various fluids is not well known. Patents of possible interest in the area, i.e., patent disclosing dispensing apparatus comprising a turntable which has a plurality of fluid receptacles mounted thereon and which is rotatable to permit a desired receptacle to be selected, i.e., so that the contents thereof can be dispensed, include: U.S. Patent Nos. 3,321,108 (Bowe); 2,951,617 (Brock); 3,015,415 (Marsh et al); 3,066,830 (Heiss et al); 3,125,252 (Heiss et al); 3,074,597 (Felts); 3,178,058 (Ogren); 3,122,272 (Marsh); 2,975,939 (Russell et al); 3,042,259 (Engel); 3,374,811 (Goosman).

Briefly considering these references, the Bowe patent discloses a printing ink dispenser including a turntable with a plurality of upstanding cylindrical collars for receiving printing ink tubes of various colors and a vertical plunger for causing the desired amount of ink to be ejected through a gate. The DeBrock patent discloses an automatic paint pigment proportioning and dispensing machine, employing a plurality of individual reservoirs and associated pumps, wherein the color and amount of pigment can be selected. The Marsh et al patent discloses mixing and dispensing apparatus wherein mixed-to-order paints are dispensed from reservoirs by multi-stroke plungers into a common container. The Heiss et al patents disclose dispensing machines for paints and the like which include rotatable nozzle cleaners or wipers. The Felts patent discloses a pigment measuring and dispensing device including a plurality of reservoirs or storage tanks individually secured to radially extending arms for measuring out and discharging different combinations of colors. The Ogren patent discloses a pigment dispensing machine employing a rotatable carrier wherein a selected receptacle or reservoir can be rotated to a dispensing position to discharge the contents hereof. The Marsh patent discloses a dispenser apparatus for dispensing made-to-order paints including a manually operated dispensing pump. The Russell et al patent discloses coatings of different colors wherein paints and other liquids are dispensed singly from a plurality of storage reservoirs into a common paint can. The Engel patent discloses a paint colorant dispensing machine which automatically delivers to a receiving vessel predetermined amounts of different colorants to be mixed with a predetermined amount of base paint to produce a mixed paint of a desired color. The Goosman patent discloses a liquid measuring and dispensing apparatus including a plurality of rotatably driven measuring compartments and associated orifices with spring biased slide valves.

It should be understood that, as noted above, the dispensing of viscous liquids such as paste inks present specific problems and that, for that reason, many prior art dispensing units, including most if not all of those discussed above, are not suitable or practical for accurately dispensing such viscous liquids.

In accordance with the invention, a dispensing apparatus is provided which, among other important advantages, enables relatively small amounts (low weights) of viscous liquids to be dispensed in a highly accurate manner.

The present invention is particularly adapted for use in the automatic dispensing of commercial paste inks, carton inks, UV/EB inks, metal decorating inks, web heatset spot colors, web news spot colors, and the like. The automated dispensing unit of the invention provides many important advantages over the prior art techniques used for the same purposes including reduced batch time, increased production throughput, more accurate weigh-up and reduced TX work-off batches.

The automatic dispensing unit of the invention provides consistent batch to batch quality, is convenient to operate as will be apparent, provides minimum mess (an important factor in handling past inks), reduces manpower to a minimum, and reduces product loss.

According to one embodiment of the invention, a dispensing system is provided for accurately dispensing relatively small amounts of product such as paste inks and like viscous materials, the dispensing system comprising: a rotatable turntable: a plurality of product receptacles mounted in circumferentially spaced relationship on the turntable and containing different product (e.g., different paste inks and other ingredients) to be dispensed, each of the receptacles including a control valve through which product contained therein is dispensed; weighing means, located at the dispensing station, for weighing product dispensed from the receptacles and for producing an output in accordance therewith; dispensing control means, located at a dispensing station adjacent to the path of travel of the turntable, for controlling operation of the control valve of a receptacle located at the dispensing station so as to control dispensing of product from that receptacle, the dispensing control means comprising actuator means for controlling opening and closing of the receptacle control valve and a controller means for, responsive to the output of said weighing means, controlling said actuator means so as to provide full opening of the control valve of a receptacle positioned at the dispensing station during a first period of a dispensing operation, the duration of which period is determined by the weight of product dispensed reaching a pre-selected level, and so as to provide partial closing of that control valve during a later period of the dispensing operation prior to fully closing that control valve; and drive means for providing rotation of the turntable so as to enable different product receptacles to be positioned at the dispensing station.

Preferably, a dispensing assisting means is located at the dispensing station adjacent to the path of travel of the turntable for applying pressure to a receptacle or cannister positioned at the dispensing station so as to assist in dispensing the contents thereof. Advantageously, this dispensing assisting means comprises a pneumatically actuated piston. In a preferred embodiment, a follower plate is provided which is received in the receptacle or cannister and which is, in use, contacted by the piston to provide dispensing of product from the associated receptacle, the follow plate being disposed in sealing relation with the side walls of the receptacle to prevent overflow of the ink contained therein when pressure is applied by said piston. Advantageously, the follower plate includes an outer (peripheral) recessed portion at the lower side thereof for assisting in preventing the creation of a vacuum at the end of the stroke of the piston, thereby making the follower plate easier to remove.

Preferably, the drive means employed comprises electrical motor means controlled by the controller means. The motor means preferably includes a reversible electrical motor. Advantageously, a (reversible) braking motor is employed, and, in accordance with an advantageous embodiment, the motor means further comprises a drive gear driven by the reversible motor and a ring gear secured to the turntable and driven by the drive gear.

The system preferably further comprises cleaning means for cleaning off excess product from a control valve after a dispensing operation. The cleaning means preferably comprises at least one cleaning pad disposed adjacent to the path of travel of the turntable at a level to engage the dispensing end of the control valve and to thereby wipe off excess product therefrom when the turntable is rotated. Advantageously, a pair of such cleaning pads are provided at locations on opposite sides of the control valve during a dispensing operation so as to effect cleaning of the control valve regardless of the direction of the next rotation of the turntable during the overall dispensing operation.

Preferably, the control valve includes a rotatable valve actuator, and the actuator means of the dispenser control means comprises gripper means for, under the control of the controller means, engaging the valve actuator and providing controlled rotation thereof to provide the fully open, partially closed, and fully closed states of the control valve. In one preferred embodiment, the gripper means comprises a pair of movable gripper jaws. In a further preferred embodiment, the control valve includes an actuator having a slot therein and the gripper means includes a gripper actuator member which, in operation, is received in the slot on the control valve actuator.

Advantageously, the system further comprises sensor means, located adjacent to the path of travel of the turntable, for sensing the arrival of a predetermined receptacle at the location of the sensor means and for transmitting a corresponding output signal to the controller means. The sensor means preferably comprises an electro-optical sensor and receiver, and in one preferred embodiment, is located at the dispensing station.

The drive means employed for the turntable preferably includes means (such as the reversible motor referred to above) for providing both clockwise and counterclockwise rotation of the turntable, and the controller means preferably includes means, responsive to the output signal from the sensor means referred to above, for determining which direction of rotation provides the shortest path of travel to the dispensing station for a selected receptacle from which product is to be dispensed and for providing rotation of the turntable in the direction so determined.

The controller means employed preferably fur-

ther comprises a rotatable control member for providing rotation of the actuator means to effect opening and closing of the control valve of a receptacle positioned at the dispensing station, and electromechanical sensing means for sensing when the control member has rotated to a predetermined angular position, corresponding to a desired control valve opening, and for causing termination of the rotation of the control member at that position.

The electromechanical sensing means referred to above advantageously includes a control cam having at least two notches in the periphery thereof and a microswitch assembly, including an actuator member disposed so as to engage said periphery, for producing an output control signal when said actuator member engages in a notch in the periphery of the control cam. In this embodiment, the actuator means preferably comprises a pneumatically operated gripper device, the control member comprises the control shaft of an electrically controlled pneumatic actuator for said gripper device, and the control cam is mounted on the control shaft.

Preferably, an indexing means is provided for providing accurate positioning of the turntable. Advantageously, this indexing means includes at least one light source-light receiver unit or set disposed adjacent to the path of travel of the turntable and cooperating with a series of circumferentially spaced "flags", carried by the turntable and disposed to interrupt the light beam received from the light source by the receiver, to indicate the positioning of the turntable. Two such sets are preferably employed.

The dispenser control valve preferably comprises a ball valve and a valve seat on which the ball valve is received, the valve seat including an output opening through which product is dispensed under the control of the ball valve, and portions of the valve seat adjacent to the outlet opening being inclined away from the opening to enhance dispensing of product.

In accordance with a further embodiment or aspect of the invention, a dispensing system is provided for accurately dispensing relatively small amounts of product such as paste inks and like viscous materials, the dispensing system comprising: a rotatable turntable; a plurality of product receptacles mounted in circumferential spaced relationship on the turntable and containing different product (e.g., paste inks and other ingredients) to be dispensed, each of said receptacles including a control valve through which product contained therein is dispensed; drive means for providing rotation of the turntable so as to enable different product receptacles to be positioned at said dispensing station; weighing means located at said dispensing station for weighing product dispensed from the receptacles and for producing an output in accordance therewith; dispensing control means, located at a dispensing station adjacent to the path of travel of said turntable, for controlling operation of the control valve of a receptacle located at said dispensing station so as to control dispensing of product from that receptacle, the dispensing control means including actuator means for controlling opening and closing of the receptacle control valve; and a controller means, operatively connected to the weighing means and the actuator means and including data processing and storage means for storing information relating to the product contained in each of said receptacles including data relating to a predetermined weight-based dispensing cutoff level for each product, for, based on the output of the weighing means and the data relating to the dispensing cutoff level for the receptacle positioned at the dispensing station, controlling the actuator means so as to provide closing of the control valve of the receptacle positioned at the dispensing station when the weight of dispensed product reaches the cutoff level.

In accordance with the preferred embodiment of the invention discussed above, the controller also provides for partially closing of the valve prior to full closure thereof, this partial closure of the valve being based on a further predetermined weight-based dispensing cutoff level for each product.

Many other features and advantages of the invention will be set forth in, or apparent from, the detailed description of preferred embodiments of the invention which follows.

Figure 1 is a partially schematic perspective view of the automatic dispensing system of the invention.

Figure 2 is a partially schematic front elevational view, partially in cross section, of the system of Figure 1 illustrating the rotational drive unit, and with some components omitted for purposes of simplicity;

Figure 3 is a partially schematic side elevational view of the rotational drive unit of figure 2, with the system housing and other components omitted;

Figure 4 is a partially schematic top plan view, partially in cross section and partially broken away, of the system of Figure 1;

Figure 5 is a detail, in front elevation, of the rotational drive unit of Figure 2;

Figure 6 is a detail, in top plan, of the turntable of the system of the invention;

Figure 7 is a detail, in side elevation, of a support arrangement for the turntable of the invention;

Figure 8 is a schematic side elevational view of the dispensing station of the system, showing a

dispensing assembly in accordance with a preferred embodiment of the invention;

Figure 9 is a schematic side elevational view of a reference location of the system of the invention, illustrating assemblies used in producing indexing and "home" signals, respectively, in accordance with one preferred embodiment of the invention;

Figure 10 is a schematic front elevational view of the dispensing station of the embodiment of Figure 8;

Figure 11 is a cross section view of a dispensing valve assembly in accordance with a preferred embodiment of the invention;

Figure 12 is a detail of the valve actuator of the valve assembly of Figure 11;

Figure 13 is a schematic cross section of a product receptacle or cannister showing the construction of a follower plate in accordance with a preferred embodiment of the invention;

Figure 14 is a schematic block diagram of the major components of the control system of the invention;

Figures 15(a) and 15(b) to Figures 19(a) and 19(b) are schematic side and end elevational views respectively illustrating the basic steps in a dispensing operation;

Figure 20 is a schematic front elevational view of a detail of the system of the invention, illustrating a hydraulic lifter or tilting assembly and a mixer assembly, which are also indicated schematically in Figures 1 and 4; and

Figure 21 is a side elevational view of the mixer assembly of Figure 20.

Referring first to Figure 1, which is a perspective view of the overall system of the invention including the accessory units, a main housing 10 of generally rectangular shape houses a turntable or carousel 12. Turntable 12 is rotatable so as to bring a selected one of a plurality of ink canisters 14 mounted in equally spaced relationship around the periphery of the turntable 12 into a predetermined position at a dispensing station 16. At this station, the ink or other ingredient contained in the selected canister 14 is dispensed into a blend can or weigh receptacle 18 disposed upon a weigh scale or load cell 20. The scale 20 is supported within a window or opening 22 in housing 10 at a convenient level above the ground so that user can readily remove blend can 18 from dispensing station 16 when all of the ingredients to be mixed have been dispensed.

A series of storage shelves 24 are provided in one side wall of housing 10 to house a color monitor and CPU 26 as well as to provide storage for other items, such as a computer keyboard, a label printer, a ticket printer, labels, disks, files, reference books, manuals, tools and the like, which are indicated but are not specifically identified by reference numeral in Figure 1. A series of access panels or doors, two of which are indicated at 28 and 29 in Figure 1, provide access to the interior of housing 10.

Further storage is provided by a laterally disposed support and storage unit 30 which is positioned adjacent to housing 10 and which includes a series of access doors 32 along one side thereof. The top of storage unit 30 defines working surface 34 on which a mixer unit 36, described below in connection with Figure 21, is disposed. Unit 30 also houses a can tipping or hydraulic assembly 38 which is also described below in connection with Figure 20, and a pair of ultrasonic cleaning tanks 39a and 39b (see Figure 4) and may optionally include a wash-up sink (not shown) or the like.

Referring to Figures 2, 3, and 4 and also to Figures 5 and 6, the interior of housing 10 and the details of the construction of an mounting arrangement for the turntable 12 are shown. As is perhaps best seen in Figure 2, which is a front view, with housing 10 shown in cross section and including support and storage unit 30 (but omitting the mixing unit 36), and Figure 3, which is a side elevational view of the interior of housing 10 in which the walls of housing 10 are omitted, the turntable mounting arrangement includes a machine base 40 mounted on machinery mounts 41. As shown in Figure 4, the base 40 is itself formed by an outer square frame member 40a connected at the corners by gussets 40b, an internal square frame member 40c the corners of which are secured to the midpoints of the sides of outer frame member 40a, and at least one transverse strut or beam 40d. As illustrated in Figures 2 and 3, base 40 supports, by means of an intermediate support frame 44 formed by four pillars or uprights or beams 46, four horizontal beams 48, and four support pads 50 at the corners of frame 44, a turntable base member 52.

Turntable base 52, as is also shown in Figures 2 and 3, comprises a frame comprising a pair of relatively large hollow structural beams 54 supported on mounting pads 56 which are mated to and rest on support pads 50 of frame 44, as well as a series of transverse connecting beams 58. This overall construction is best seen in Figure 6 which is a detail, drawn to an enlarged scale, of the frame formed by beams 54 and 58.

As is best seen in Figure 3, beams 54 extend outwardly from the support frame 44 on one side thereof to provide a support for weight scale a load cell 20 as well as a ball transfer and piston support assembly 60. The latter includes vertically extending inverted U-shaped suspension member or support 62 (Figure 2) including an outwardly extending bracket 62a (Figure 3) from which is suspended a

pneumatic piston or plunger assembly 64 used in forcing the ink out of the canisters 14. As indicated in Figure 2, suspension member or support 62 extends upwardly from a rail member 66 in the form of an inverted U which is affixed at the lower ends of the legs thereof to beams 54.

As illustrated in Figure 4, turntable 12 preferably includes an additional series of openings or apertures arranged in circle for receiving and storing replacement canisters indicated at 14' and shown in the inverted positions thereof, i.e., upside down, with the dispenser valve indicated 104', on top.

As indicated in Figures 3, 4 and 6, rail 66 supports a pair of ball guide assemblies 68 for turntable 12. One of the guide assemblies 68 is shown in Figure 7, and as illustrated, comprises a fixed bracket 70 which is affixed to support rail 66 and which supports a lower ball transfer unit 72 (Transbearco Ltd., No. 1163) and an intermediate shim 74 beneath turntable 12 and an adjustable bracket 76 which is adjustably affixed to support rail 66 by a fastener 78 and which supports a ball transfer unit 80 (Transbearco Ltd., No. 1162) disposed above turntable 12.

To provide a spacial reference between components, Figure 6 indicates the ink canister sweep arc at IC, the ball transfer arc at BT and the turntable perimeter at TT. As is also shown in Figure 6, a turntable bearing plate 82 and a gear drive mounting plate 84 are mounted at different levels on the frame formed by beams 54 and 58. Bearing plate 82 includes a plurality of holes 84 arranged around a circle in equally spaced angular relationship, as illustrated. As is best seen in Figure 5, and to a lesser extent, Figure 3, a drive unit 86 comprises a brake motor 88 (e.g., NEMA 556, 1/4 HP, 120/240 Vdc, 1 pH, 60 Hz, 1750 rpm) a gear box reducer 90 (e.g., Transbearco Style DXVMQ 300:1 ratio No. OXVMQ 1262-300), an upstanding pinion 92 (Rotex Model No. P4-3.5D2) and a slew bearing 94 (Rotek Model No. L616E92) mounted on turntable mounted bearing plate 98 secured to turntable 12. Pinion 92 engages and drive a ring bearing 96 secured to bearing plate 82 of Figure 6 by bolts (not shown) secured in holes 84 in bearing plate 82. As indicated in Figure 5, slew bearing 94 rotates around ring bearing 96 as bearing slew bearing 94 is being driven by pinion 92. As shown in Figures 2, 3 and 5, bearing plate 98 is secured to turntable base or frame 100 formed by orthogonal pairs of spaced beams 102.

Housing 10 also contains a centrally located ventilation fan 97 (Figure 2), radiant heater panels or like heater devices 99 (Figure 2) for maintaining the temperature with housing 20 at a predetermined selected level in order to avoid overheating (typically 35° to 40° C), an air compressor 101 (Figure 4) for regulating the pressure and to accommodate pressure changes and electrical control panel 103 (Figure 4).

Turning now to the dispensing control aspects of the invention, as set forth above, Figures 1, 2 and 3 show a blend can or like receptacle indicated at 18 in these figures disposed beneath a selected canister 14 which has rotated with the turntable 12 to the home position 16 at which dispensing takes place. As illustrated, for example, in Figure 3 and shown in Figures 8 to 10 and in more detail in Figures 11 and 12, each canister 14 includes a control valve assembly 104 which controls dispensing of the contents therefrom. Each valve assembly 104 is disposed at the lower end of a downwardly projecting dispenser spout or tube 14a through which flows the contents of the associated canister 14.

Referring in particular to Figures 11 and 12, each control valve assembly 104 includes a slotted actuator member 106 (Figure 12) which is adapted to be engaged by an actuator member 108 of a gripper mechanism indicated at 110 in Figures 8 and 10, which includes an outwardly projecting control portion or key 106a (Figure 12). Actuator member 108 is mounted on, and rotates with, a rotary disc or plate 112 of the gripper mechanism 110. Rotation of plate 112 is controlled by a pneumatic controller, denoted 114, which, when initially actuated, also controls axial or longitudinal movement of rotary plate 112 between a withdrawn or inactive position out of the path of valve assembly 104 and an extended or active position thereof wherein actuator member 108 is moved so as to engage in the slot defined by the slotted actuator 106 of the control valve assembly 104 prior to causing rotation thereof in the controlled stepwise (two-step) controlled manner described below. As shown in Figures 8 and 10, gripper mechanism 110 and pneumatic controller 114 are mounted on and supported by a wall support 113 and disposed on opposite sides thereof.

As described above, in the illustrated embodiment (see, in particular, Figure 12), gripper actuator member 108 engages in the slot formed in valve actuator 106 (Figure 12) and accordingly, the tolerances and relative dimensions of the parts are such that actuator member 108, when rotated, will cause rotation of valve actuator 106. In an alternative embodiment of the gripper mechanism, which is described below in connection with Figures 15(a) to 19(b), a pair of gripper members or jaws are provided on opposite sides of valve actuator 106 which, when actuated, move towards each other to positively engage valve actuator prior to controlled rotation of the valve actuator. Although these two embodiments are preferred, it will be understood that other embodiments of the gripper mechanism

can also be employed which provide initial gripping followed by controlled rotation of the valve actuator.

As illustrated in Figure 11, control valve assembly 104 comprises a valve housing 116 including a valve seat 118 on which a ball valve 120 seats. Housing 116 also includes an opening 122 in a wall thereof through which extends the control or key portion 106a (see also Figure 12) of valve actuator 106. As shown, ball valve 120 includes a flow control passage 120a through a diameter thereof which, in the fully-open position of the valve illustrated, extends vertically. The free end of the control portion 106a engages in slot or aperture 120b in ball valve 120 so that rotation of actuator member 106 controls rotation of ball valve 120. The control passage 120a through the diameter of ball valve 120 cooperates with matching openings 118a and 116a in valve seat 118 and valve housing 116, respectively, to control the flow of ink out of the bottom of the control valve assembly 104 in a two-step operation described more fully below. It will be appreciated that the angle of passage 106a in ball valve 106 relative to matching openings 116a, 118a, will control the amount of ink dispensed and, thus, that by providing selective rotation of ball valve 106 the dispensing process can be controlled. It is noted that the opening 116a in the bottom of valve housing 116 is of a generally frusto-conical shape with the sides thereof sloping away as illustrated. It has been found that this shape assists in providing a clean cutoff of the ink being dispensed so that any errors in the actual amount dispensed, as compared with the amount desired to be dispensed, can be kept within narrow limits.

It is also noted that other dispensing heads or valve constructions can be used and, in this regard, in an alternative embodiment, a pneumatically actuated gripper mechanism can be used to control the opening and closing of valve manifolds to control the rate at which the ink is being dispensed.

As shown in Figure 10, an arrangement is provided for wiping off the dispensing orifice of control valve assembly 104 in the form of a pair of substantially identical wiping devices 115 and 117 disposed on support frame members 119 and 121 on opposite sides of valve assembly 104. Wiping device 115 comprises a foam layer 115a disposed on a metal support plate 115b while wiping device 117 similarly comprises a layer of foam 117a deposed on a metal support 117b. It will be understood that one or the other of the foam layers 115a or 117a will come into contact with, and wipe off, the dispensing orifice of the control valve assembly 104 of a canister 14 after dispensing of the contents thereof, depending on the direction in which turntable 12 is next rotated.

Before considering the actual dispensing operation further, it is noted that positioning of a selected dispenser 14 at the dispensing station 16 is controlled by the CPU unit 26. In accordance with one preferred embodiment of the invention, the system is returned to the "home" position thereof at the end of each complete dispensing operation, i.e., after all of the ingredients of a batch have been dispensed, in an automatic mode of operation of the system. Thus, for example, in a sixteen canister system, canister "No. 16" is returned to dispensing station 16 as illustrated in Figure 9, and the other canisters 14 are disposed in numerical sequence on the turntable or carousel 12 at predetermined equispaced angular locations around the periphery of the turntable 12. It will be understood that whether canister "No. 16" or some other canister is initially positioned at the dispensing station is an arbitrary choice and another canister (e.g., canister "No. 1") can equally well be selected. Thus, if the operator wishes to select canister "No. 10", the computer 26 will calculate the shortest path for that canister to the dispensing station 16, i.e., whether a clockwise or counter-clockwise path is shortest, and, in the exemplary embodiment under consideration, will provide for rotation of canister "No. 10" in the clockwise direction and, in particular, will cause motor 88 to step the selected canister through six units to the dispensing station 16 so that controlled dispensing of the contents thereof can take place. The next ingredient is dispensed in the same way, i.e., the computer will calculate the shortest distance to dispensing station 16 for the canister that contains the selected ingredient, and motor 88 is energized, under the control of computer 26 to move that canister in that direction to the dispensing station 16. As stated above, after all of the ingredients of a particular batch have been dispensed, the system is returned to the home position thereof.

A reference or "home" signal used in control of the positioning of a selected canister 14 at the dispensing station 16 is provided by an optical switch assembly generally denoted 124 and illustrated in Figure 9. It is to be understood that Figure 9 is a side elevational view of a canister 14 which is positioned diametrically opposite to that shown in Figure 8 and thus is located at the back of the overall dispensing unit. In particular, in the embodiment illustrated in Figure 9, optical switch assembly 124 is located on a support wall, indicated at 125, at the back of the unit. However, it will be appreciated that the location of the optical switch assembly 124 can be varied and in the embodiment illustrated in Figure 3, the optical switch assembly 124 is located on wall support 113 behind gripper mechanism 110. Optical switch assembly 124 comprises a light source (e.g., a photodiode) 126 and a light receiver (e.g., a photocell) 128

disposed in spaced relation on opposite sides of the path of travel a flag 130 mounted for rotation with turntable 12. In the embodiment illustrated in Figure 9, flag 130 is secured to and extends outwardly from one of the canisters 14. The canister is selected so that when the canister is positioned adjacent to switch 124, the system is in the home position thereof. In the exemplary embodiment illustrated in Figures 2 and 3, flag 130 is mounted on turntable base 100 so as to depend downwardly therefrom and is positioned thereon at the location of canister "No. 16" which, in the exemplary embodiment under consideration, has for its "home" location the dispensing station 16.

Returning to the embodiment of Figure 9, as illustrated therein, the photodiode 126 and the corresponding photocell 128 of optical switch assembly 124 are arranged vertically so that the light path therebetween will be blocked or interrupted by the passing therethrough of the flag 130, which, as noted above, extends outwardly from one of the canisters 14 and rotates with turntable 12. Stated differently, flag 130 is disposed so as to follow a path of travel between light source 126 and the corresponding light receiver 128 upon rotation of the turntable 12 to, or past, the "home" position of the system, which, in the exemplary embodiments under consideration, has been arbitrarily chosen to be the position wherein canister "No. 16" is located at dispensing station 16. When the beam of the light between the photodiode 126 and the photocell 128 is interrupted by the flag 130, there is a corresponding change in output of photocell 128 and a resultant signal is transmitted to computer or CPU 26. This signal is used by CPU 26 to determine the current position of the turntable 12 and to thereby determine the degree of angular rotation necessary for the turntable to advance to a desired destination.

In a preferred embodiment, a braking unit built into or associated with motor 88 is used to ensure that the turntable stops at the final desired position, under the control of CPU 26 as described in more detail herein below.

Referring again to Figure 9, a further optical switch arrangement or assembly 127 is provided which comprises two photodiode-photocell pairs or sets 129 (one of which is shown) disposed in spaced relation on the support wall 125 on which optical switch assembly 124 is located. Each of the pairs or sets 129 is disposed vertically (similarly to the pair or set forming switch assembly 124) and the two pairs 129 are spaced apart on opposite sides on a predetermined fixed location relative to turntable 12. A plurality of flags 131 are mounted on corresponding brackets 132 on turntable 12 (see also Figure 8) and cooperate with photocell-photodetector pairs 129 in a manner similar to that described above for optical switch assembly 124. (In the embodiment illustrated in Figures 2 and 3, flags 131 depend downwardly from turntable base 100, together with single control flag 130, and in this embodiment, the two pairs or sets (not shown in Figures 2 and 3) are also mounted on support wall 113 behind gripper 110.)

Flags 131 cooperate with optical switch arrangement 127 to provide indexing of the turntable 12. In this regard, it will be appreciated that a pair of signals is produced by each flag 131 as that flag passes between the photodiode and photodetector of the pairs or sets 129, and that when a flag 131 is positioned at a location between the pairs 129, so that no signal is produced but so that a signal will be produced if the turntable rotates in either direction, precise positioning of the turntable 12 is achieved.

When a selected canister 14 is brought to rest at the dispensing station 16, two basic operations take place viz., actuation of a plunger assembly 64 described above in more detail in connection with Figure 3, and actuation of the control valve assembly 104 for the selected canister 14 to provide controlled dispensing of the contents thereof. As described above and illustrated in Figure 3, an inverted U-shaped mounting support or upright 62, including a support bracket 62a, supports the downwardly depending pneumatic cylinder 64 which, in turn, controls the movement of an associated plunder head 64a down into the upper, open end of a canister 14 to force the contents of the canister out through the dispensing nozzle assembly 104. It will be understood that the plunger assembly 64 bay not be required in dispensing all of the ingredients to be mixed in a particular batch, and would not, for example, be used in dispensing thinners and the like. It will be appreciated that whether or not the plunger assembly 64 is used in dispensing a particular ingredient or component to be mixed is controlled by the operator and, in a fully automated operation, is programmed into the system commands.

Before considering the dispenser valve actuation operation, reference is made to Figure 13, which shows a follower plate 132 which is adapted to cooperate with the plunger head or piston 64a as the latter is caused to move downwardly into a canister 14. The basic purpose of follower plate 132 is to prevent leakage of ink from the top of a canister 14, especially during the application of pressure by plunger 64a. As illustrated, the follower plate 132 comprises an upper plate 134, preferably made of a metal such as aluminum and including an outer peripheral ring 135 (preferably made of polytetrafluoroethylene) which engages the side walls of the associated canister 14 to provide sealing, an intermediate rubber platelike member 136,

which also engages the side walls of the associated canister 14, and a bottom plate 138, also preferably of metal such as aluminum, all secured together by a central screw 140. The diameter of the bottom plate 138 is substantially less than that of the rubber plate 136 so that the former does not extend to the wall of the canister 14. As a result, an air space is created at the bottom of the follower plate 132 which assists in breaking up the vacuum forces which are often created at the bottom of the canister 14 at the end of the plunger stroke and which make retraction of the plunger or piston 64a difficult. It will be understood that follower plate 132 prevents the piston 64a from directly contacting the ink in the canister 14 and thus keeps the piston 64a clean. The screw 140 in the middle of follower plate 132 permits the follower plate 132 to be removed from the canister when the latter is empty, using a special tool (not shown).

Turning now to the valve actuation control operation, as discussed above, an important feature of the invention involves the use of a two-step full open/partial open valve actuation sequence, in the nature of a "dribble" feed, so as to achieve the required weighing accuracy. The basic sequence is to fully open the valve for an initial dispensing period, to then partially close the valve (e.g., to a position where the valve is one-quarter open) and then to fully close the valve. As discussed in more detail below, the times during which the valve is fully open and partially open can be preprogrammed depending on the type of ink or other ingredient to be dispensed.

This overall operation is perhaps best understood by reference to Figure 14 which is a block form electrical circuit diagram of the overall control system, and to Figures 15(a), 15(b) to Figures 19-(a), 19(b) which show the sequence of steps employed in the dispensing operation. As illustrated in Figure 14, the output of computer or CPU 26 is connected to control panel 103 (also shown schematically in Figure 4) containing a series of control modules which are described in more detail below. More specifically, control modules are provided which include a gripper control module 144 and three valve control modules 146, 148 and 150, which serve to control the dispensing operation. Other control modules include a pair of motor control modules 152 and 154, a "master index" module 156 and a piston control module 158.

Generally speaking, and considering the dispensing operation of the system, control signals are transmitted from CPU 24 to the gripper control module 144 for the gripper mechanism 110 to first control engagement thereof with control valve actuator 106 for valve actuator assembly 104 and thereafter, in sequence, to valve control modules 146, 148 and 150 to provide the required rotation of valve actuator 106 needed to first provide opening of the valve, to then provide partially closing thereof and to finally provide full closing thereof, as mentioned above and as is described in more detail below.

As illustrated in Figure 8 as well as Figures 15-(a), 15(b) to Figures 19(a), 19(b), a pair of disc or plate cams 160 and 162 are provided which rotate with the gripper 110 and which include notches or slots in preset angular positions around the periphery therein that cooperate with microswitch activating cam followers to signal that the gripper 110, and thus the ball valve 120 of valve assembly 104, have both been rotated to the desired position. More specifically, cam 160 includes notches 160a and 160b which cooperate with respective cam followers 164a and 166a of microswitches 164 and 166, respectively positioned at angularly spaced locations around the periphery of cam 160. Similarly, a notch 162a in cam 162 cooperates with cam follower 168a of a further microswitch 168 that is positioned adjacent to the periphery of cam 162. The functions of microswitches 164, 166 and 168, are also schematically illustrated in Figure 13, and, as indicated, microswitch 164 signals that the valve 120 is in the proper "fully open" position, microswitch 166 signals that the valve is in the proper "one-quarter open" position and microswitch 168 signals that the valve is in the proper "fully closed" position.

It will be understood that the arrangement of cams, cam followers and microswitches described above is provided to ensure precise positioning of the valve, and to thus ensure that the desired amount of ink is dispensed, and that this arrangement can be dispensed with if the precise positioning of the valve can otherwise be provided, e.g., by the gripper controller.

Considering a typical dispensing operation, reference is made to Figures 15(a), 15(b) to Figures 19(a), 19(b) which illustrate an embodiment similar to that of Figure 8, but employing, as noted above, a gripper 170 having jaws that open and close to engage the actuator 106 of valve assembly 104. An example of a gripper of this type is the precision gripper made by Barrington Automation while the pneumatic actuator can be of the type made by Worcester (39/40 series).

Referring first to Figures 15(a) and 15(b), the system is shown in the rest position thereof wherein gripper 170 is open and valve 120 of valve assembly 104 is fully closed. In a first, pre-dispensing step, illustrated in Figures 16(a) and 16(b), gripper 170 is closed responsive to a signal from gripper module 144 (Figure 13), so as to engage valve actuator 106.

Next, a signal from module 146 causes the actuator 106 to be turned (e.g., clockwise in the

exemplary embodiment under consideration) to the fully-open position. As illustrated in Figures 17(a) and 17(b), when cam 160 is rotated to an angular position corresponding to the fully open position, cam follower 164a drops into notch 160a in the periphery of the cam 160 and in doing so activates microswitch 164 thereby producing an output signal which terminates rotation of the gripper 170.

The time during which the control valve 120 of valve assembly 104 is maintained in the fully opened position thereof is a function of a number of factors including the nature of the ink being dispensed (e.g., viscosity, etc.), and as indicated in Figure 14, the weight of the ink that has been dispensed is determined by load cell or scale 20. The weight value at which the valve opening is changed from fully open to partially open (e.g., one-quarter open) is determined in calibrating the system and is 90% of the expected weight in the exemplary embodiment under consideration. Thus, referring to Figure 13, when the weight of the ink received in blend can 18, as determined by weigh scale or load cell 20, reaches this preselected or predetermined value, a signal is transmitted by CPU 26 to valve control module 148 and actuator 106 is turned or rotated accordingly.

As illustrated in Figures 18(a) and 18(b), the second microswitch 166 is activated during this time sequence, when the gripper 170, and thus valve actuator 106, is precisely rotated to the partially (25%) closed position, at which time the signal produced by microswitch 166 acts through computer 26 to terminate gripper rotation.

When the amount of ink dispensed into the blend can 18 as determined by weigh scale 20 reaches the desired level (e.g., 97% of the expected weight), a signal from CPU 26 to valve control module 150 will cause gripper 170 to be rotated back to the fully-closed position. As indicated in Figures 19(a) and 19(b), the third microswitch 168 is activated when the valve actuator 106 is rotated to the precise, predetermined fully closed position so as to terminate rotation of the gripper 170. When this is accomplished, the jaws of gripper 170 are caused to open by a signal from the CPU 26 so that the system is returned to the rest state shown in Figures 15(a) and 15(b) and is thus readied for the next ingredient.

After all of the inks and other ingredients are dispensed into blend can 18 and thoroughly mixed by mixer unit 36 (Figures 1 and 4), the contents thereof are transferred to one or more, usually smaller receptacles for distribution to a customer, for temporary storage or for a like purpose. This transfer may be facilitated by use of the hydraulic can tilting or tipping (lifting) assembly 38 indicated in Figures 1 and 4 and illustrated in more detail in Figure 20. Tilting assembly hydraulic lifter) 38 basically comprises a hinged plate 180 which is raised (as indicated in dashed lines) or lowered (as indicated in solid lines) in a controlled manner by extension and retraction of a hydraulic control arm 182 under the control of a hydraulic controller 184, to thereby provide controlled pouring from blend can 18.

Prior to dispensing the contents of blend can or ink pot 18, mixer unit 36 (referred to above in connection with Figures 1 and 4) is used to thoroughly mix and blend these contents. Referring particularly to Figure 21, which is a side elevational view of mixer unit 36, a motor 186 and drive unit 188 are mounted on a base 190 by a hydraulic lift device 192 which enables the motor 186 and drive unit 188 to be raised and lowered relative to the base 190. Drive unit 188 drives a stirrer assembly 194 comprising a stirrer rod 196, which is detachably or removably attached to the rotary drive output shaft 188a of drive unit 188 by an arrangement comprising a pin 196a and an L-shaped slot 188b, as illustrated, and a flexible blade 198, preferably fabricated of polytetrafluoroethylene, which is adapted to be inserted into an ink pot or blend can 18. Ink pot 18 is removably secured to base 190 by an arrangement including a shaped notch 18a in a skirt 18b formed on the bottom of ink pot 18 and a pin 190a provided on an upstanding support pad on which ink pot 18 is supported and around which skirt 18b extends. An important feature of the mixing unit 36 is that the unit is operated at low speed, not greater than 60 rpm, in that this provides substantially improved mixing. It is to be understood that mixer 36 and hydraulic lifter assembly 38 can be integrated into a single unit wherein the ink pot 18 would be removably secured to the upper plate 180 of assembly 38. However, in a presently preferred embodiment, the units are separate, as indicated schematically in Figure 4, so that the different operations, i.e., mixing and tilting, can take place at the same time using two different ink pots.

Briefly considering the overall operation of the unit or system of the invention and referring particularly to Figure 14 and focussing on the computer control for the system, after gaining entry to the system by entering the correct password or passwords (e.g., different passwords are preferably used for programs, formulas and batching) in the computer 26, the operator checks an inventory database which contains information for each canister such as the ingredient by code in each canister and the quantity of the ingredient in each canister. It will be understood during start-up of the system or during refill, the corresponding weights of the ink in each of the canisters 14 must be entered into the fields of the inventory database. The computer 26 also stores an ingredient

database which includes for each choice of the ingredients contained in the canisters 14, the ingredient code, name and hazard code, as well as data relating to the dribble point, cutoff point, accuracy percentage, cost and the like. A formula database includes the formula name and code, the ingredients in per cent, quality control specifications, manufacturer's instructions and the like.

To begin the operating procedure for a selected formula, the operator inputs appropriate data in computer 24, including the formula number, name option, quantity (e.g., in kilograms), finished product container code, operator number, the customer's name and the date. When the operator input is completed, the computer will generate a batch number and a ticket reading (including all inputs) and will display the formula by weight and record the starting time. It will be understood that after the operator input page is completed, all of the ingredients will be displayed on a batch display page.

The batching procedure then starts with checking operations based on interaction with the database described above. By simply hitting the correct keys, the operator initiates weigh up operation which is then carried out automatically. The basic weigh up operation has been described above and begins with movement of a canister 14 containing one of the selected ingredients to the dispensing station 16. As described hereinabove, the computer 26 will determine the shortest route to dispensing station 16, i.e., whether clockwise or counterclockwise and, referring to Figure 14, will transmit a signal to either module 152 (clockwise) or module 154 (counterclockwise). The selected module will then cause motor 88 to step the turntable or carousel 12 around the required angular distance or arc to the dispensing station 16. The direction of movement of turntable 12 provided by motor 88 is controlled simply by reversing the direction of current flow through motor 88.

As indicated previously, the "master index" module 156 in cooperation with optical switch 124 signals when a predetermined canister 14 arrives the dispensing station or arrives at a further reference point (e.g., in the embodiment of Figures 8 and 9) so that the computer 26 can calculate the position of the turntable 12 and determine the amount of rotational movement required to move a selected canister to the dispensing station 16.

As explained above, when the selected canister 14 reaches the dispensing station 16, the piston head 64a will exert pressure on the canister, as required. (In this regard, as mentioned above, some ingredients such as solvents do not require the use of piston assembly 64.) The gripper operation then begins and as described in some detail above in connection with Figures 15(a), 15(b) to Figures 19(a), 19(b), the gripper 170 is first closed, and the valve 104 is fully opened. When a predetermined percentage of the expected weight is dispensed into blend can or mixing pot 18, e.g., about 90% in the exemplary embodiment under consideration, the valve is partially closed, i.e., so as to be one-quarter open in the preferred embodiment. This is accomplished by a signal from the computer 24 to the control panel 103 and in particular to control module 166, with final positioning being effected through the operation of microswitch 166. In the exemplary embodiment under consideration, when about 97% of the expected weight is dispensed, the canister control valve is completely closed, under the control of CPU 26, control module 150 and microswitch 168. It is noted that a small amount of ink will be attached to valve assembly 104 and falling ink from the valve will top off the amount of ink actually dispensed so that the actual weight will be very close to expected or desired weight. In this regard, an accuracy of ± 1 gram has been achieved.

Upon the completion of a dispensing operation for a first canister, the computer 26 will transmit a signal to cause the gripper 170 to open, and to cause the piston head 64a to be removed from the top of the canister 14. The turntable 12 will then be caused to rotate to bring the next canister 14 into registration at the dispensing station 16. The procedure will be repeated upon all ingredients of the selected formula have been dispensed.

The expected total weight will include the amount requested, the adjusted weight for strength compensation, and, typically, an additional 1.5% of the weight for loss compensation.

As weighing of each ingredient is completed, the actual final weight, as measured by weigh scale 20, will be recorded beside the expected weight on the display page.

When the batch operation is completed, the operator can command a cost report from the computer which will then be printed out. The ink mixture in ink pot 18 is at this time ready for mixing or blending using the mixing unit 36 in the manner described above.

Although the present invention has been described relative to exemplary embodiments thereof, it will be understood by those skilled in the art that variations and modifications can be effected in these exemplary embodiments without departing from the scope and spirit of the invention.

Claims

1. A dispensing system for accurately dispensing relatively small amounts of product such as paste inks and like viscous materials, said dispens-

ing system comprising:
a rotatable turntable;
a plurality of product receptacles mounted in circumferentially spaced relationship on said turntable and containing different product to be dispensed, each of said receptacles including a control valve through which product contained therein is dispensed;
weighing means located at said dispensing station for weighing product dispensed from said receptacles and for producing an output in accordance therewith;
dispensing control means, located at a dispensing station adjacent to the path of travel of said turntable, for controlling operation of the control valve of a receptacle located at said dispensing station so as to control dispensing of product from that receptacle, said dispensing control means comprising actuator means for controlling opening and closing of the receptacle control valve and a controller means for, responsive to the output of said weighing means, controlling said actuator means so as to provide full opening of the control valve, of a receptacle positioned at said dispensing station during a first period of a dispensing operation the duration of which period is determined by the weight of product dispensed reaching a pre-selected level and so as to provide partial closing of that control valve during a later period of said dispensing operation prior to full closing of that control valve; and
drive means for providing rotation of said turntable so as to enable different product receptacles to be positioned at said dispensing station.

2. A system as claimed in Claim 1 further comprising dispensing assisting means located at the dispensing station adjacent to the path of travel of said turntable for applying pressure to a said receptacle positioned at said dispensing station so as to assist in dispensing the contents thereof.

3. A system as claimed in Claim 1 wherein said dispensing assisting means comprises a pneumatically actuated piston.

4. A system as claimed in Claim 3 further comprising a follower plate which is received in a said receptacle and which is, in use, contacted by said piston to provide dispensing of product from the associated receptacle, said follow plate being disposed in sealing relation with the sidewalls of the canister to prevent overflow of ink when pressure is applied by said piston.

5. A system as claimed in Claim 4 wherein said follower plate includes an outer recessed portion at the lower side thereof for assisting in preventing the creation of a vacuum at the end of the stroke of the piston.

6. A system as claimed in Claim 1 wherein said drive means comprises electrical motor means controlled by said controller means.

7. A system as claimed in Claim 6 wherein said motor means includes a reversible electrical motor.

8. A system as claimed in Claim 6 wherein said motor means comprises a braking motor.

9. A system as claimed in Claim 6 wherein said motor means further comprises a drive gear driven by said reversible motor and a ring gear secured to said turntable and driven by said drive gear.

10. A system as claimed in Claim 1 further comprising cleaning means for cleaning off excess product from a said control valve after a dispensing operation.

11. A system as claimed in Claim 9 wherein said cleaning means comprises at least one cleaning pad disposed adjacent to the path of travel of the turntable at a level to engage the dispensing end of the control valve and to thereby wipe off excess product there from.

12. A system as claimed in Claim 1 wherein said control valve includes a rotatable valve actuator, and the actuator means of said dispenser control means comprises gripper means for, under the control of said controller means, engaging said valve actuator and providing controlled rotation thereof to provide the fully open, said partially closed, and said fully closed states of said control valve means.

13. A system as claimed in Claim 12 wherein said gripper means comprises a pair of gripper jaws.

14. A system as claimed in Claim 12 wherein said control valve includes an actuator having a slot therein and said gripper means includes a gripper actuator member which, in operation, is received in said slot on the control valve actuator.

15. A system as claimed in Claim 1 further comprising sensor means located adjacent to the path of travel of said turntable for sensing the arrival of a predetermined receptacle at the location of the sensor means and for transmitting a corresponding output signal to said controller means.

16. A system as claimed in Claim 15 wherein said sensor means comprises an electro-optical sensor and receiver located near said dispensing station.

17. A system as claimed in Claim 15 wherein said drive means includes means for providing both clockwise and counterclockwise rotation of said turntable, and said controller means includes means, responsive to the output signal from said sensor means, for determining which direction of rotation provides the shortest path of travel to the dispensing station for a selected receptacle from which product is to be dispensed and for providing rotation of said turntable in the direction so deter-

mined.

18. A system as claimed in Claim 1 wherein said controller means further comprises a rotatable control member for providing rotation of said actuator means to effect opening and closing of the control valve of a receptacle positioned at the dispensing station, and electro-optical sensing means for sensing when said control member has rotated to a predetermined angular position corresponding to a desired control valve opening and for causing termination of the rotation of the control member at that position.

19. A system as claimed in Claim 1 wherein said sensing means includes a control cam having at least two notches in the periphery thereof and a microswitch assembly, including an actuator member disposed so as to engage said periphery, for producing an output control signal when said actuator member engages in a notch in the periphery of the control cam.

20. A system as claimed in Claim 19 wherein said actuator means comprises a pneumatically or electrically operated gripper device, said control member comprises the control shaft of an electrically controlled pneumatic actuator for said gripper device, and said control cam is mounted on said control shaft.

21. A system as claimed in Claim 1 wherein said control valve comprises a ball valve and a valve seat on which said ball valve is received, said valve seat including an output opening through which product is dispensed under the control of said ball valve, and portions of said valve seat adjacent said outlet opening being inclined away from said opening to enhance dispensing of product.

22. A system as claimed in Claim 1 further comprising positioning means for sensing the angular position of the turntable and for transmitting an output signal indicative of the position of the turntable to said drive means to control positioning of the turntable.

23. A system as claimed in Claim 22 wherein said turntable includes a plurality of circumferentially spaced indicators and said sensing means comprises an optical sensor unit for sensing the presence of said indicators.

24. A system as claimed in Claim 23 wherein said optical sensor unit comprises first and second electro-optical units, each comprising a light source and a light receiver, positioned on opposite sides of a reference location.

25. A system as claimed in Claim 24 wherein each said light source comprises a photodiode and each said light receiver comprises a photocell and said indicators each comprise a flag member which interrupts the light path between said photodiode and photocell during rotation of the turntable past said reference position.

26. A system as claimed in Claim 1 wherein said system further comprises a mixer unit for mixing together different product dispensed from different receptacles into a common container, said mixer unit including a rotary mixer blade for mixing the contents of a said container and drive means for said mixer blade for rotating said blade at speed not exceeding 60 rpm.

27. A system as claimed in Claim 1 wherein said controller means includes memory means for storing, for each product contained in said receptacles, predetermined cut off weight levels at which sai control valve is to be partially closed and fully closed.

28. A system as claimed in Claim 1 wherein said controller means comprises a central processing unit for storing data relating to different formulas to be made up from the product stored in said receptacles including the formula name, identifying code, and product ingredients in per cent, identifying codes for the product stored in each of said receptacles and data relating to amount of product stored in each of said receptacles, and keyboard means for enabling an operator to enter data relating to a selected formula including the formula code and quantity to be dispensed.

29. A dispensing system for accurately dispensing relatively small amounts of product such as paste inks and like viscous materials, said dispensing system comprising:

a rotatable turntable;

a plurality of product receptacles mounted in circumferential spaced relationship on said turntable and containing different product to be dispensed, each of said receptacles including a control valve through which product contained therein is dispensed;

drive means for providing rotation of said turntable so as to enable different product receptacles to be positioned at a dispensing station;

weighing means located at said dispensing station for weighing product dispensed from said receptacles and for producing an output in accordance therewith;

dispensing control means, located at a dispensing station adjacent to the path of travel of said turntable, for controlling operation of the control valve of a receptacle located at said dispensing station so as to control dispensing of product from that receptacle, said dispensing control means including actuator means for controlling opening and closing of the receptacle control valve; and

a controller means, operatively connected to said weighing means and said actuator means and including data processing and storage means for storing information relating to the product contained in each of said receptacles including data relating

to a predetermined weight-based dispensing cutoff level for each product, for, based on the output of said weighing means and the data relating to the dispensing cutoff level for the receptacle positioned at the dispensing station, controlling said actuator means so as to provide closing of the control valve of the receptacle positioned at said dispensing station when the weight of dispensed product reaches said cutoff level.

30. A dispensing system for accurately dispensing relatively small amounts of product such as paste inks and like viscous materials, said dispensing system comprising:

a rotatable turntable;

a plurality of product receptacles mounted in circumferential spaced relationship on said turntable and containing different product to be dispensed, each of said receptacles including a control valve through which product contained therein is dispensed;

drive means for providing rotation of said turntable so as to enable different product receptacles to be positioned at a dispensing station;

weighing means located at said dispensing station for weighing product dispensed from said receptacles and for producing an output in accordance therewith;

selectably actuated dispensing assisting means located at dispensing station adjacent to the path of travel of said turntable for, when actuated, applying pressure to a receptacle positioned at the dispensing station so as to assist in dispensing the contents thereof;

dispensing control means, located at said dispensing station adjacent to the path of travel of said turntable, for controlling operation of the control valve of a receptacle located at said dispensing station so as to control dispensing of product from that receptacle, said dispensing control means comprising actuator means for controlling opening and closing of the receptacle control valve; and

a controller means for, responsive to the output of said weighing means, controlling said actuator means so as to control opening and closing of the control valve of a receptacle positioned at said dispensing station.

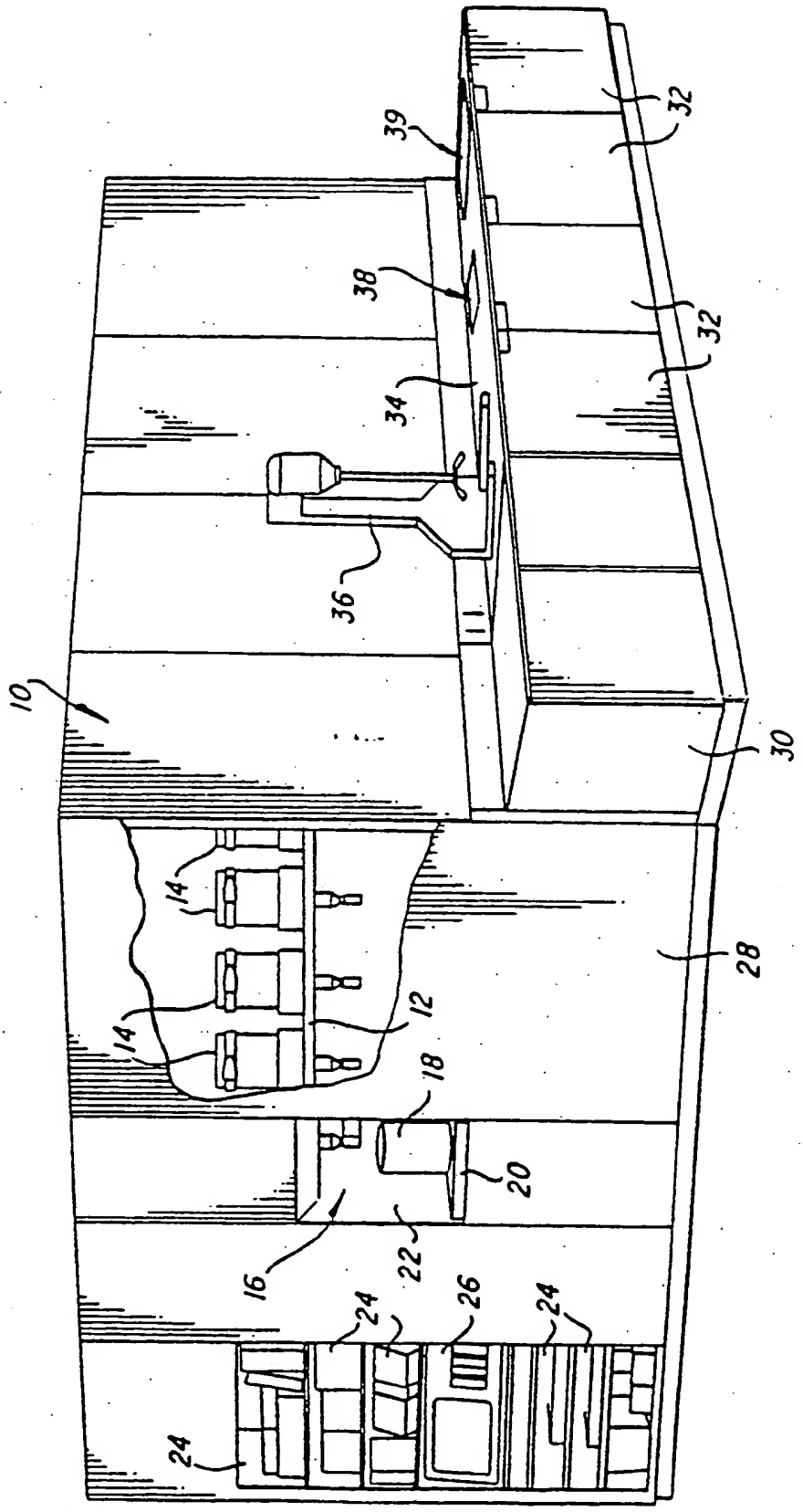
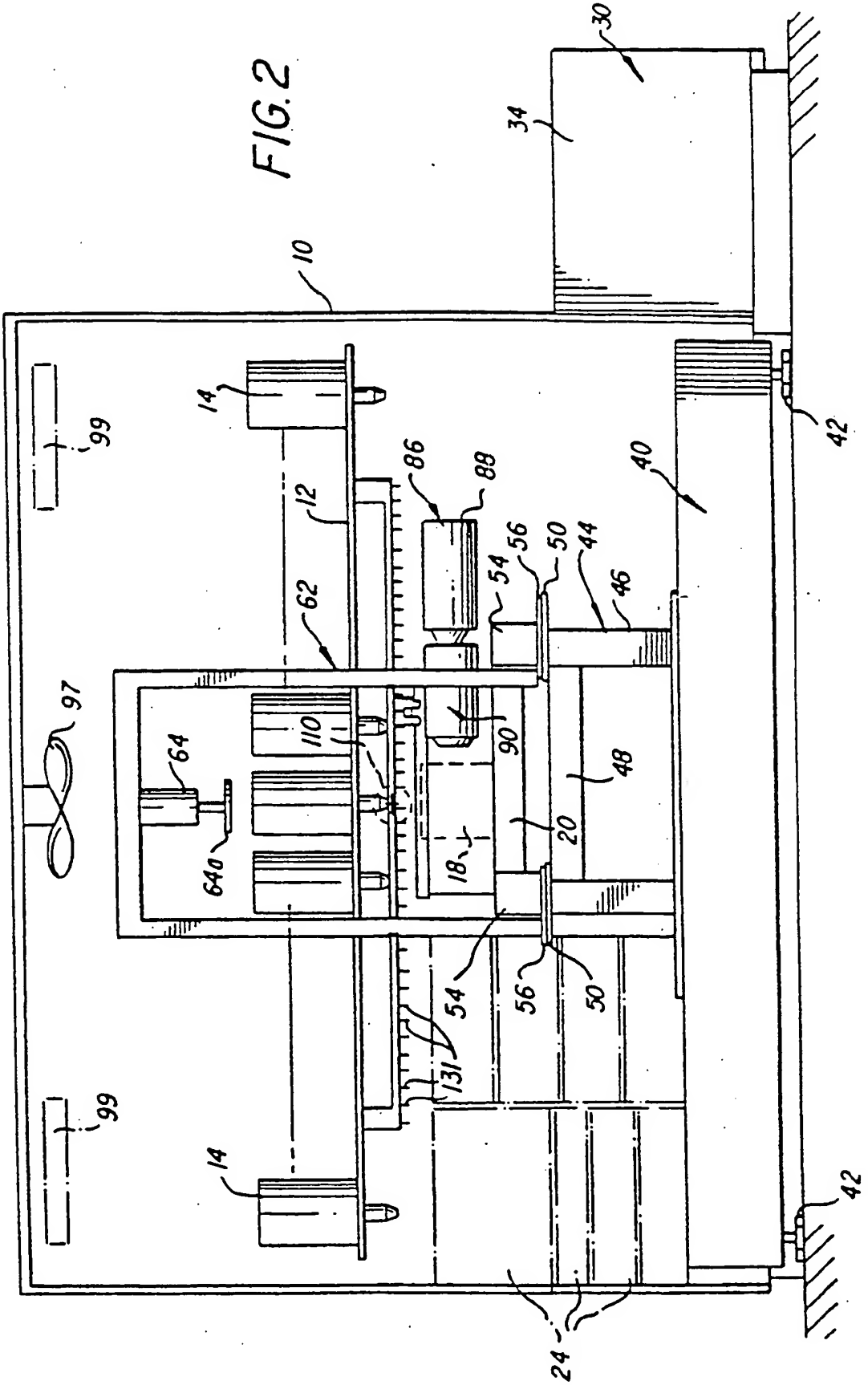


FIG. 1

FIG.2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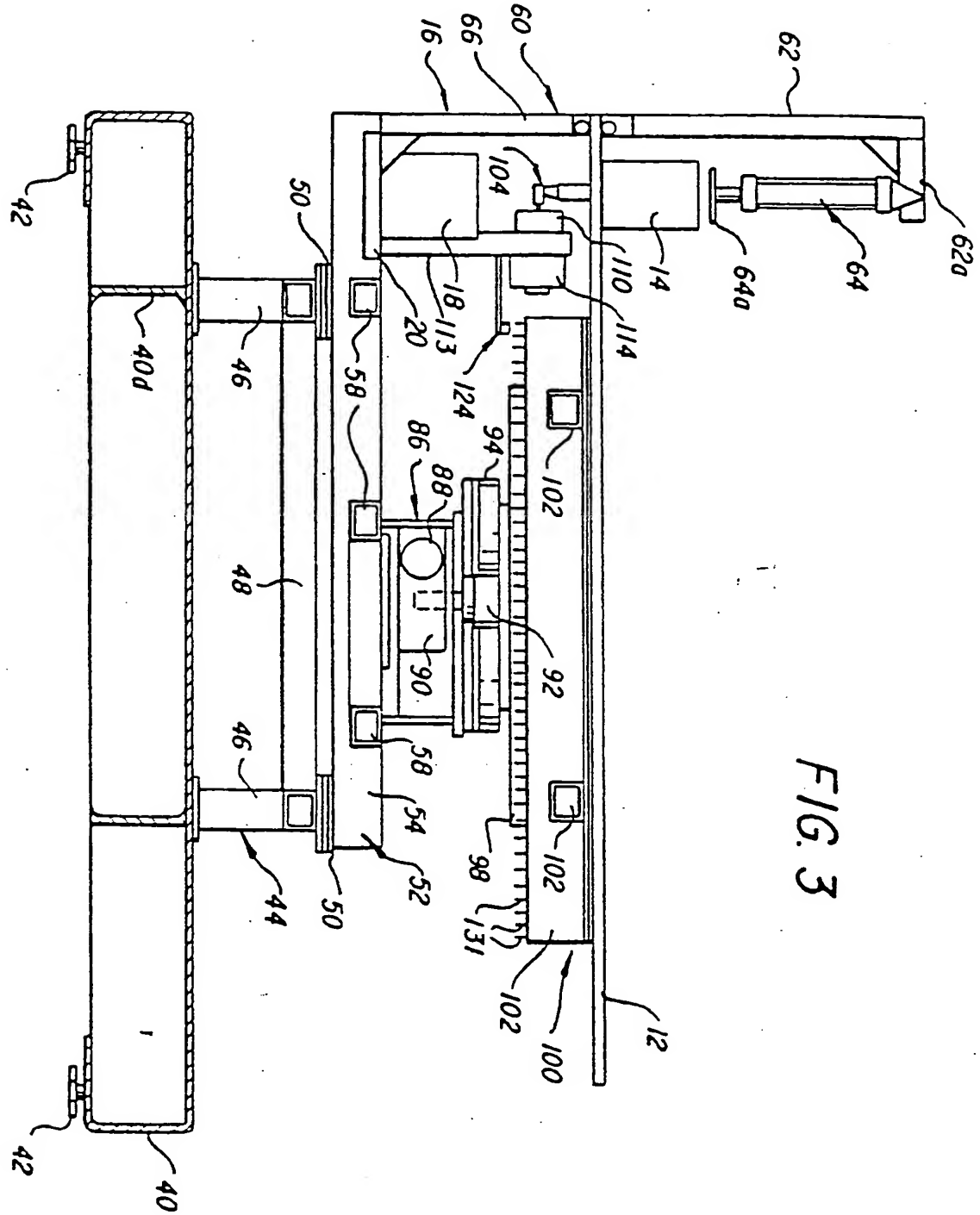
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FIG. 3

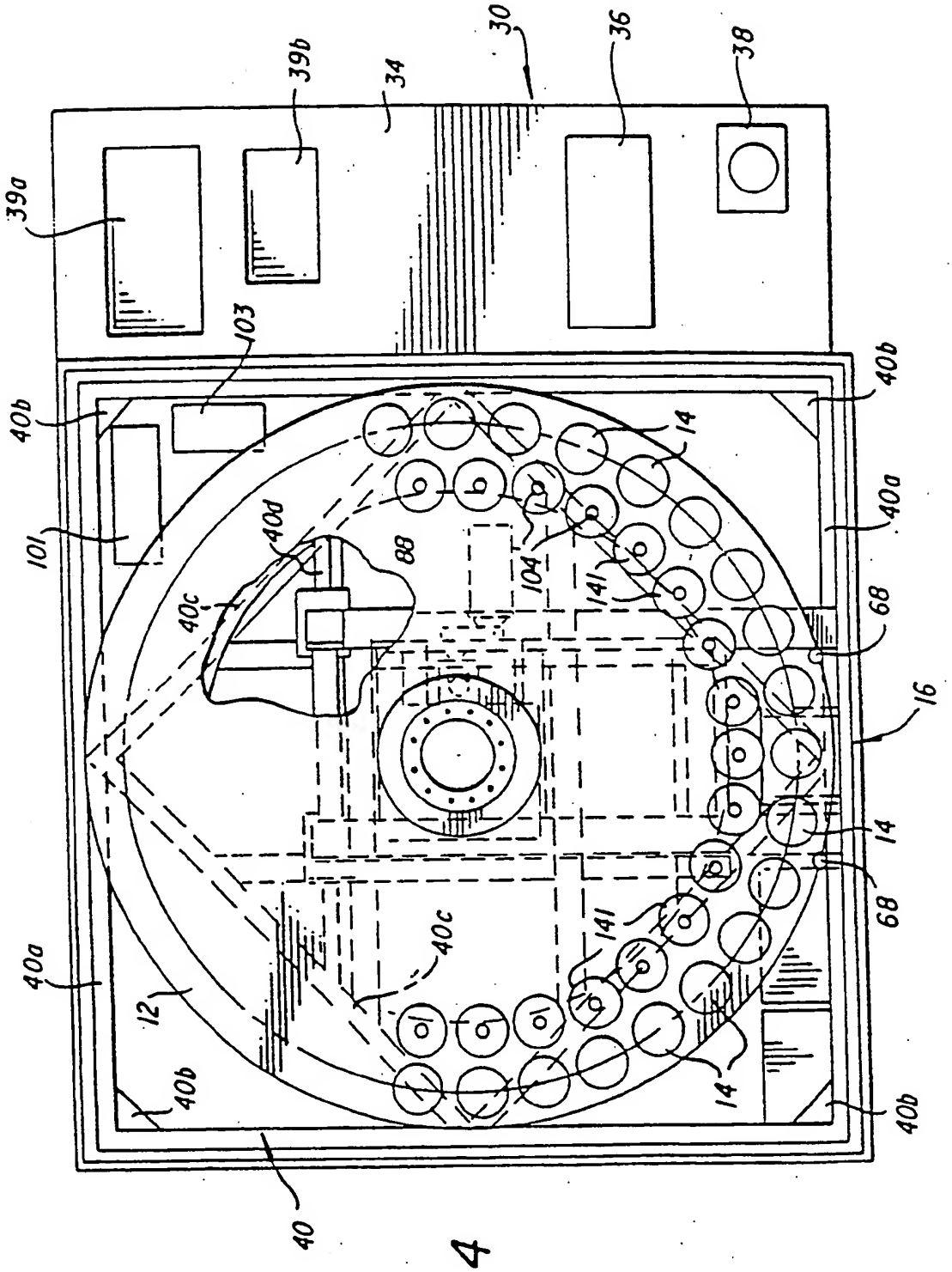
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FIG. 4

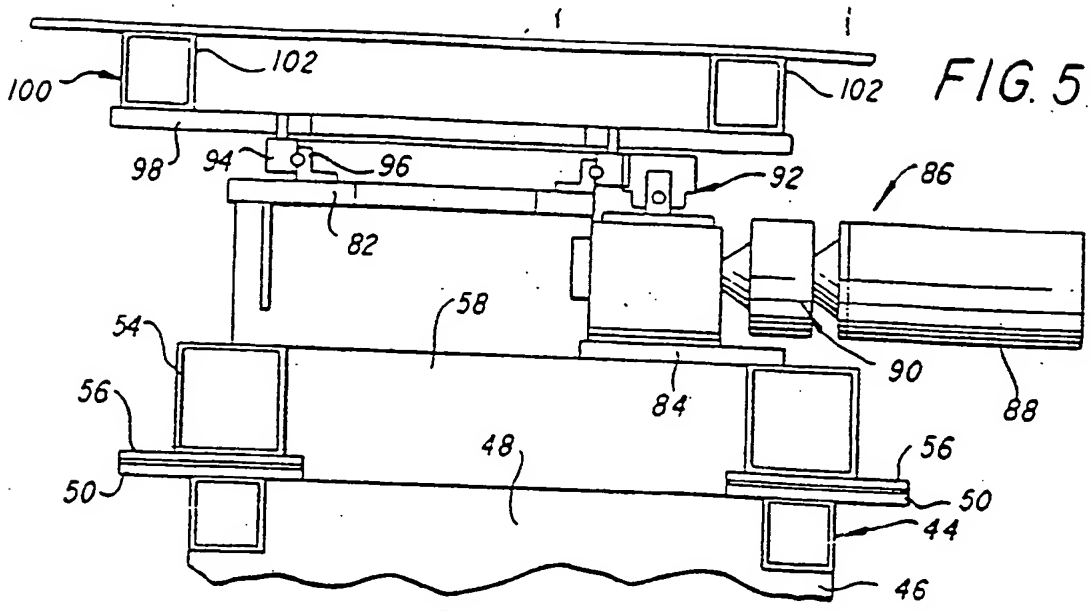

FIG. 5

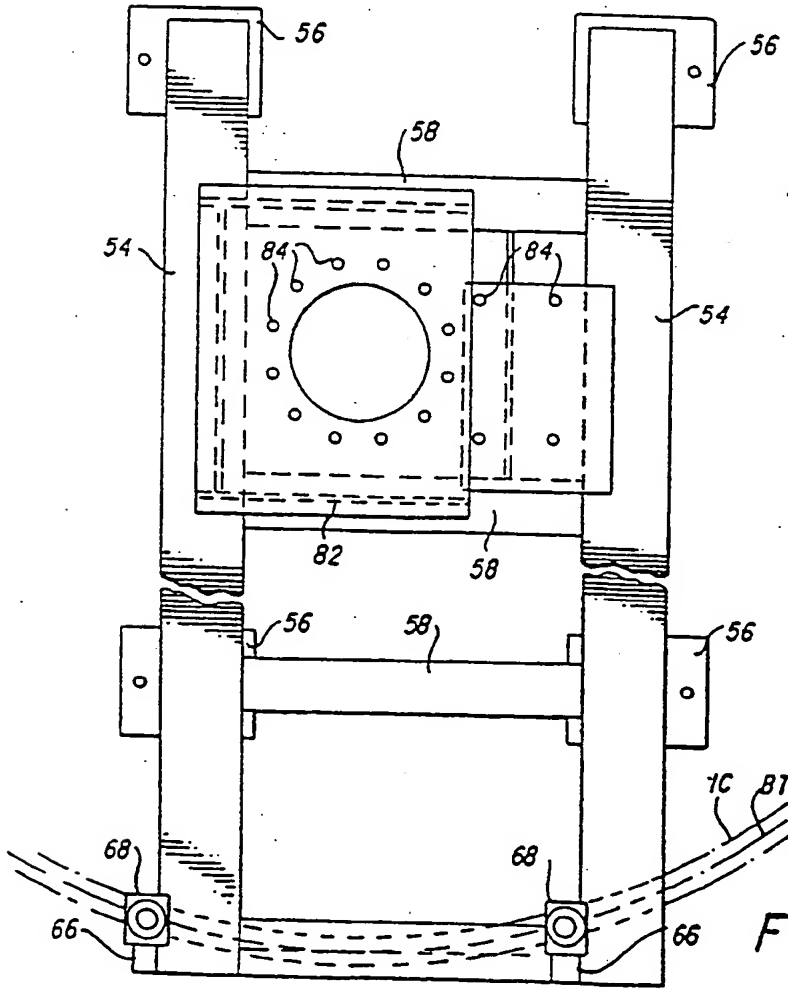

FIG. 6

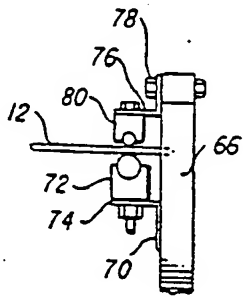

FIG. 7

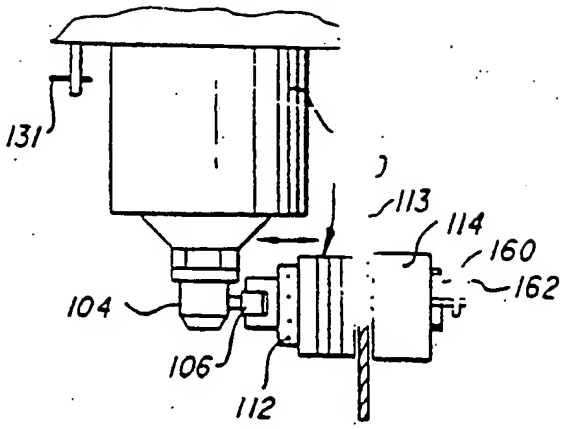

FIG. 8

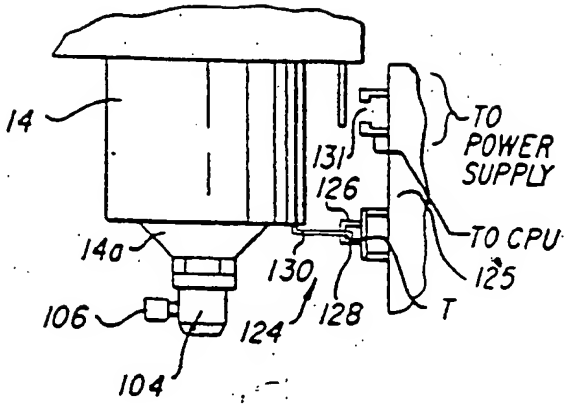

FIG. 9

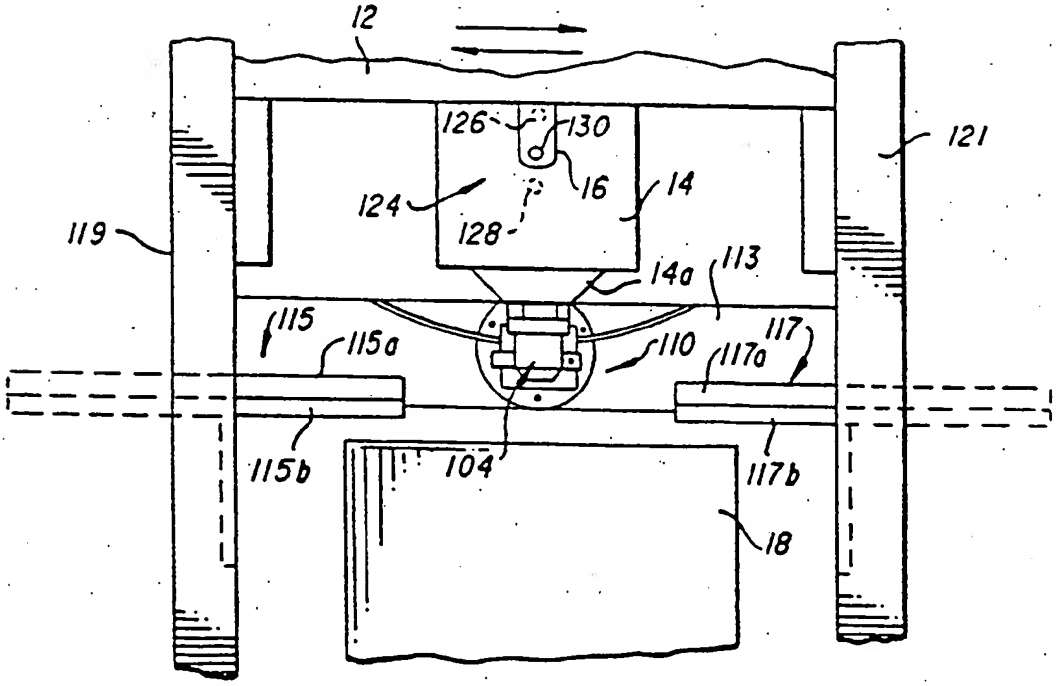

FIG. 10

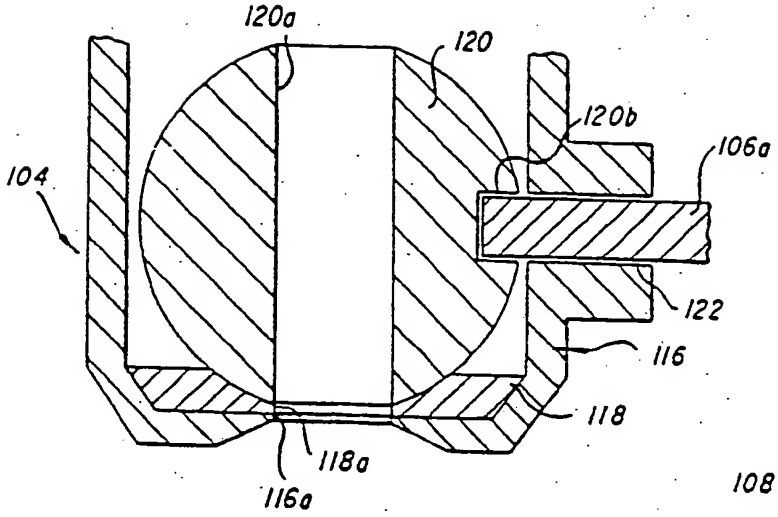

FIG. 11

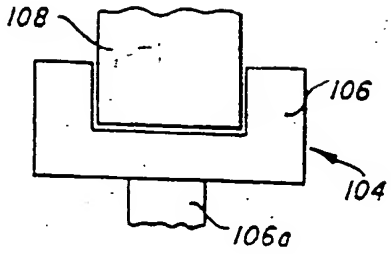

FIG. 12

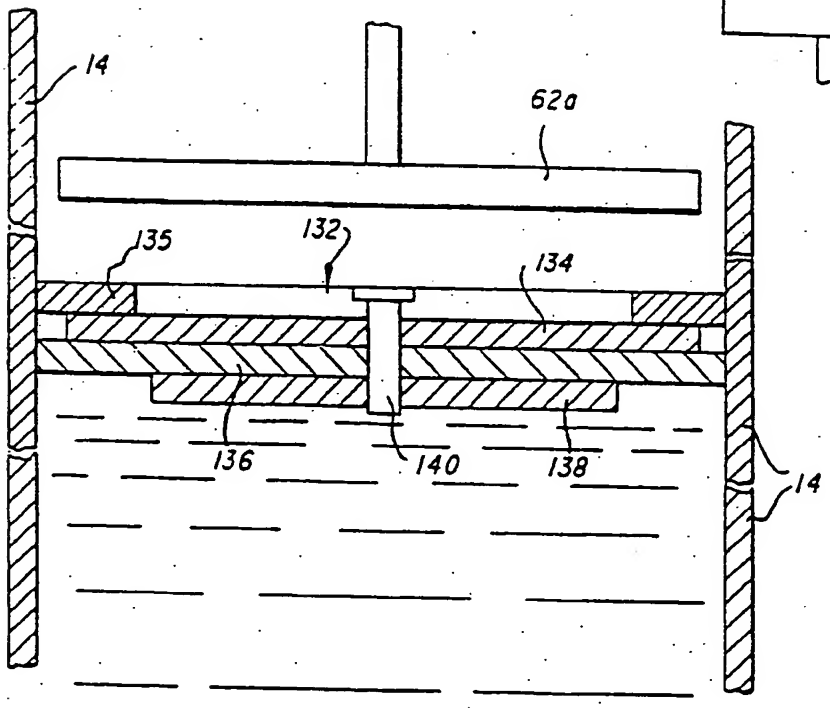

FIG. 13

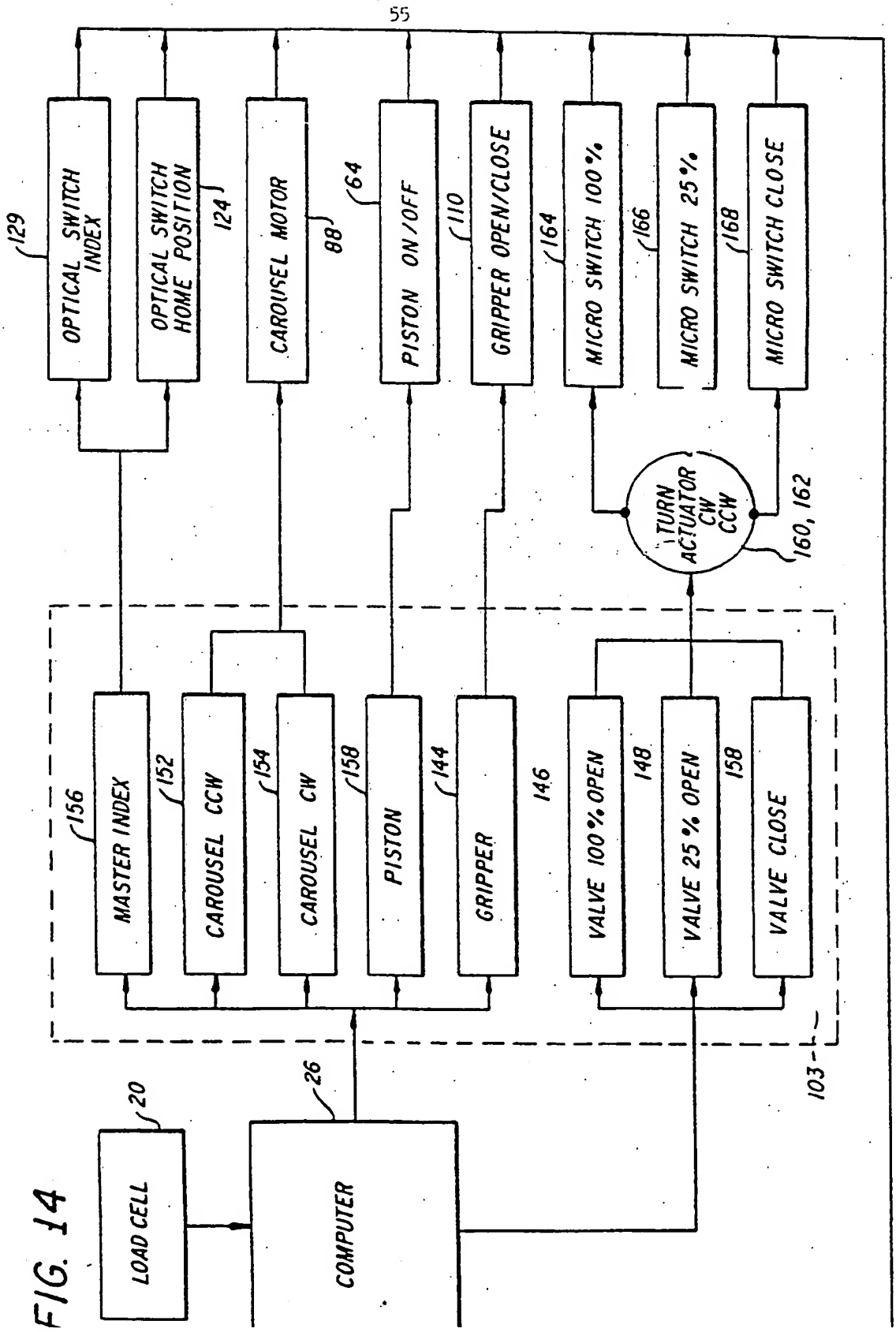
55
OPTICAL SWITCH INDEX
129
OPTICAL SWITCH HOME POSITION
124
CAROUSEL MOTOR
88
64
PISTON ON/OFF
110
GRIPPER OPEN/CLOSE
164
MICRO SWITCH 100%
166
MICRO SWITCH 25%
168
MICRO SWITCH CLOSE
TURN ACTUATOR CW CCW
160, 162
MASTER INDEX
156
CAROUSEL CCW
152
CAROUSEL CW
154
PISTON
158
GRIPPER
144
146
VALVE 100% OPEN
148
VALVE 25% OPEN
158
VALVE CLOSE
103
LOAD CELL
20
COMPUTER
26

FIG. 14

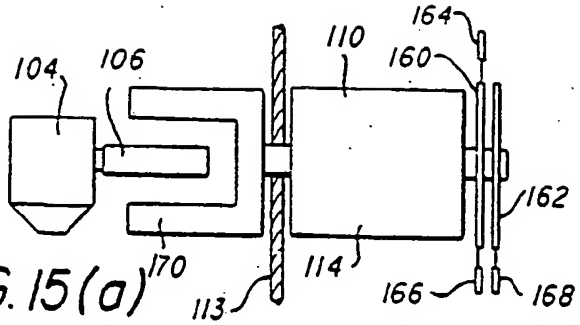

FIG. 15(a)

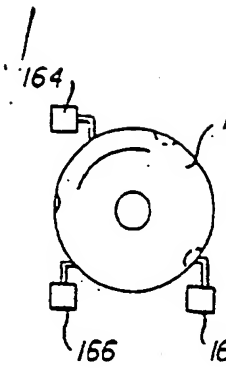

FIG. 15(b)

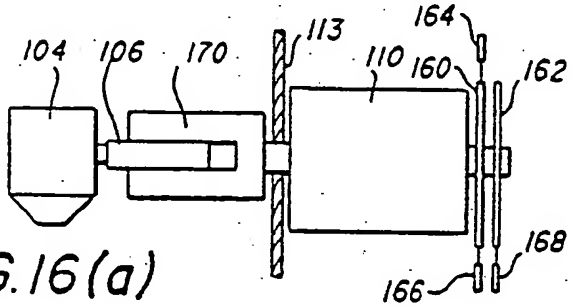

FIG. 16(a)

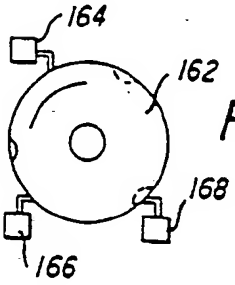

FIG. 16(b)

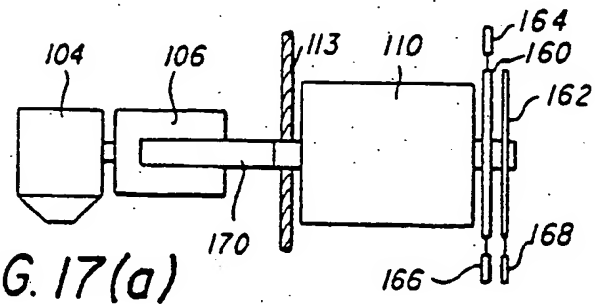

FIG. 17(a)

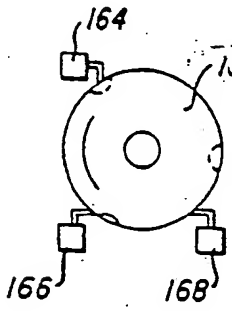

FIG. 17(b)

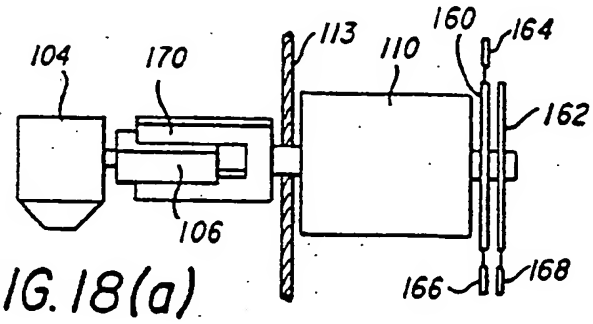

FIG. 18(a)

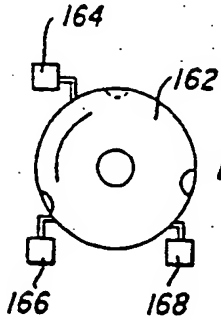

FIG. 18(b)

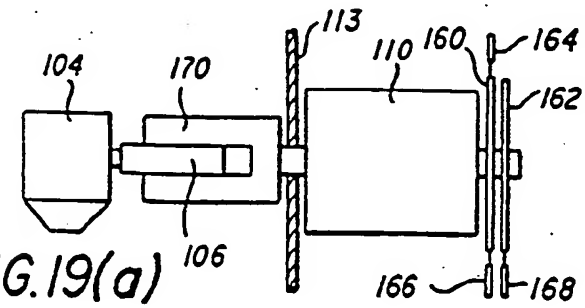

FIG. 19(a)

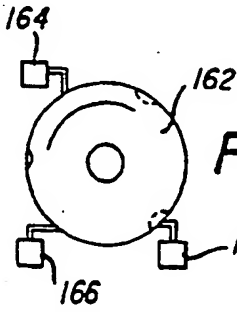

FIG. 19(b)

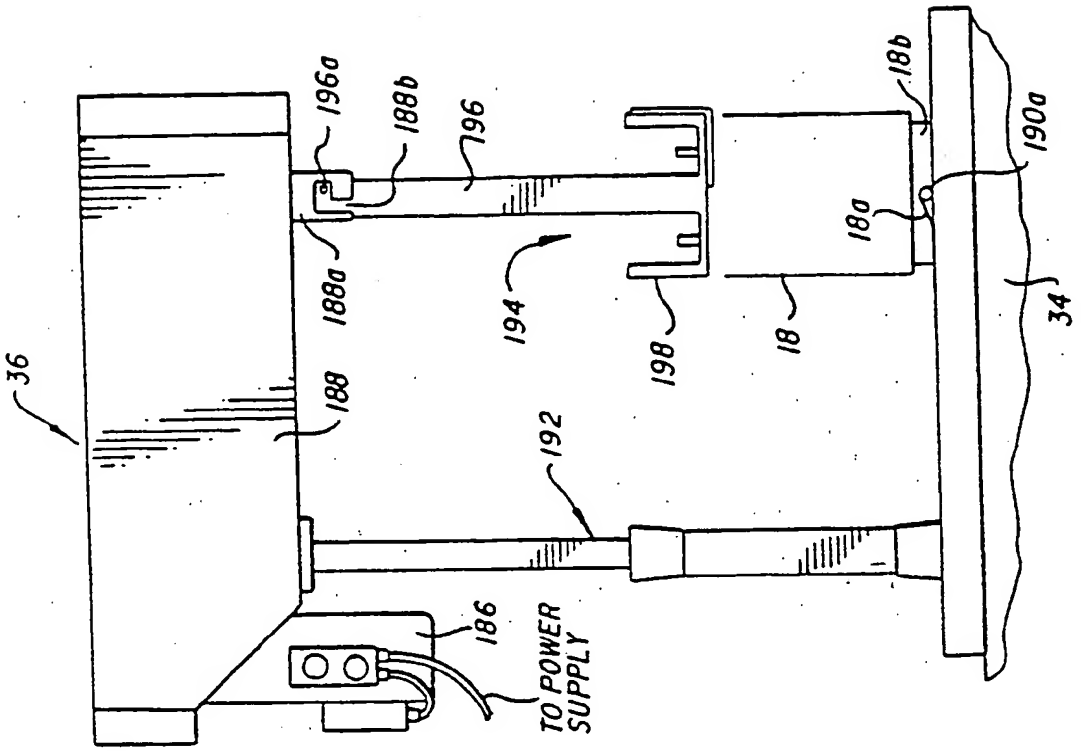
36
188
188a
196a
188b
196
194
198
18
18a
18b
190a
34
192
186
TO POWER SUPPLY

FIG. 21

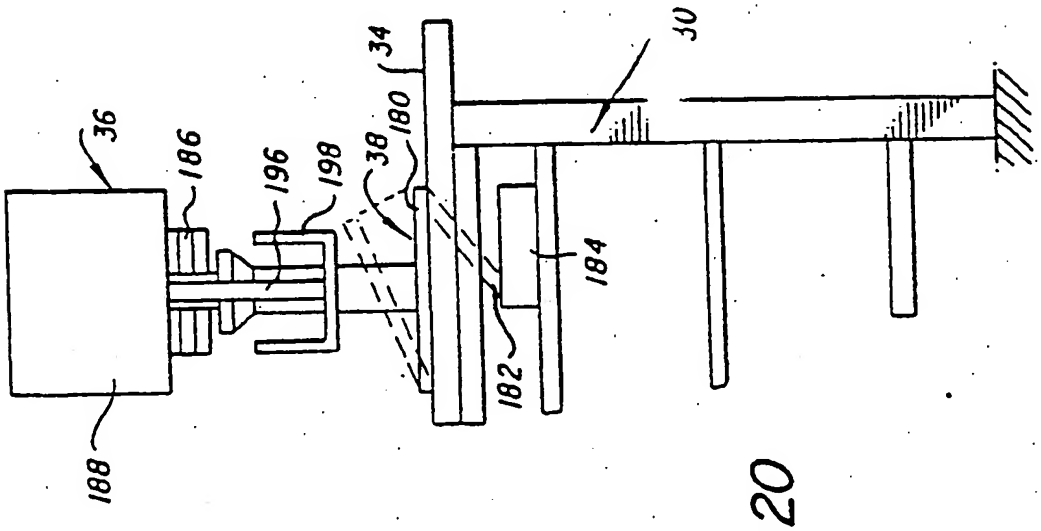
188
36
186
196
198
38
180
34
30
184
182

FIG. 20

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 10 6226

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-2 152 635 (AKZO) * Page 9, line 36 - page 10, line 27; fig. *	1,6-9, 29,30	B 01 F 13/10
A	US-A-4 046 287 (HOEKSTRA) * Column 4, line 38 - column 5, line 61; column 7, line 43 - column 8, line 2; column 14, lines 8-42; fig. *	6-9,12-25,27-28	
A	US-A-3 029 847 (BAUDHUIN) * Column 3, lines 20-52; fig. *	2-5	
A	GB-A-2 182 912 (STORK) * Abstract *	10,11	
A	US-A-4 526 215 (HARRISON) * Column 9, lines 5-34; figure 6 *	10,11	
A	US-A-4 222 448 (SUNKLE)		
A	FR-A-2 441 071 (ITALTINTO)		
A	US-A-3 074 597 (FELTS)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
B 01 F G 01 G B 41 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-07-1990	PEETERS S.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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